CLAIMS

What is claimed is:

[c001] 1. A method for digitizing portions of a waveform sent through a moisture-bearing medium comprising the steps of:

(a) providing an unshielded transmission line that passes through said medium to a latching comparator;

(b) providing a shielded transmission line connected to said latching comparator;

(c) launching a fast-transitioning waveform onto said unshielded transmission line;

(d) measuring the amplitude of a resultant waveform at a programmed point in time at said latching comparator by using a technique involving generation of timing strobes in conjunction with a measurement of amplitude by successive approximation, said technique comprising the steps of:

(d1) providing a programmable voltage reference to which said resultant waveform is compared by said latching comparator;

(d2) providing a programmable time offset for generation of a precisely-timed sampling strobe after the launching of said fast-transitioning waveform in order to sample said resultant waveform amplitude at said latching comparator, said sampling strobe being sent through said shielded transmission line to said latching comparator;

(d3) launching a multiplicity of said fast-transitioning waveform onto said transmission line and adjusting said programmable voltage reference in the manner of said successive approximation until an

amplitude representative of a composite of resultant waveform at the given point in time has been acquired; and

(d4) changing said programmable time offset to a next desired point in time and repeating steps d1 through d3 in order to acquire another amplitude representative of a multiplicity of resultant waveform at said next desired point in time until said portions of a waveform have been digitized.

[c002] 2. The method in Claim 1, wherein propagation time of said fast-transitioning waveform through said medium is calculated from said portions of a waveform, comprising the steps of:

(a) determining a characteristic slope of transition of said resultant waveform from a set of points within said portions of a waveform;

(b) locating a point of maximum slope of transition of said resultant waveform;

(c) projecting a straight line having said characteristic slope of transition through said point of maximum slope to a 0-Volt reference line; and

(d) finding an intercept point of said straight line with said 0-Volt reference line, wherein the time associated with said intercept point represents said propagation time of said fast-transitioning waveform through said medium.

[c003] 3. The method in Claim 2, wherein said propagation time is used to calculate a value for the bulk dielectric constant of said medium in contact with said unshielded transmission line.

[c004] 4. The method in Claim 2, wherein said characteristic slope of transition of said resultant waveform is used to determine a value for the conductivity of said medium in contact with said unshielded transmission line.

[c005] 5. The method in Claim 1, wherein said medium is soil.

[c006] 6. The method in Claim 1, wherein said medium is bulk grain.

[c007] 7. The method in Claim 1, wherein said medium is bulk paper.

[c008] 8. The method in Claim 1, wherein said medium is lumber.

[c009] 9. The method in Claim 1, wherein said medium is a hydrocarbon fuel.

[c010] 10. The method in Claim 1, wherein said medium is oil.

[c011] 11. A method for digitizing portions of a waveform sent through a moisture-bearing medium comprising the steps of:

(a) launching a fast-transitioning waveform onto a proximal end of a transmission line that passes through said medium to an open distal end of said transmission line;

(c) providing a latching comparator at said proximal end of said transmission line to receive a resultant waveform which contains a signal component that has been reflected from said open distal end;

(d) measuring the amplitude of said resultant waveform at a programmed point in time at said latching comparator by using a technique involving generation of timing strobes in conjunction with a measurement of amplitude by successive approximation, said technique comprising the steps of:

(d1) providing a programmable voltage reference to which said resultant waveform is compared by said latching comparator;

(d2) providing a programmable time offset for generation of a precisely-timed sampling strobe after said launching of said fast-transitioning waveform in order to sample said resultant waveform amplitude at said latching comparator;

(d3) launching a multiplicity of said fast-transitioning waveform onto said transmission line and adjusting said programmable voltage reference in the manner of said successive approximation until an amplitude representative of a composite of resultant waveform at the given point in time has been acquired; and

(d4) changing said programmable time offset to a next desired point in time and repeating steps d1 through d3 in order to acquire another amplitude representative of a multiplicity of resultant waveform at said next desired point in time until said portions of a waveform have been digitized.

[c012] 12. The method in Claim 11, wherein propagation time of said fast-transitioning waveform through said medium is calculated from said portions of a waveform, comprising the steps of:

(a) determining a characteristic slope of transition from a subset of measured points which represent that portion of said resultant waveform which contains a signal component that has been reflected from said open distal end;

(b) locating a point of maximum slope of transition from within said subset of measured points;

(c) determining a baseline reference level from which said signal component that has been reflected from said open distal end rises;

(d) projecting a straight line having said characteristic slope of transition through said point of maximum slope to said baseline reference level; and

(e) finding an intercept point of said straight line at said baseline reference level, wherein the time associated with said intercept point represents said propagation time of said fast-transitioning waveform through said medium.

[c013] 13. The method in Claim 12, wherein said propagation time is used to calculate a value for the bulk dielectric constant of the medium in contact with said transmission line.

[c014] 14. The method in Claim 12, wherein said characteristic slope of transition of said subset of measured points is used to determine a value for the conductivity of said medium in contact with said transmission line.

[c015] 15. The method in Claim 11, wherein said medium is soil.

[c016] 16. The method in Claim 11, wherein said medium is bulk grain.

[c017] 17. The method in Claim 11, wherein said medium is bulk paper.

[c018] 18. The method in Claim 11, wherein said medium is lumber.

[c019] 19. The method in Claim 11, wherein said medium is a hydrocarbon fuel.

[c020] 20. The method in Claim 11, wherein said medium is oil.

[c021] 21. A method for digitizing portions of a waveform sent through a moisture-bearing medium comprising the steps of:

(a) launching a fast-transitioning waveform onto a proximal end of a transmission line that passes through said medium to a shorted distal end of said transmission line;

(c) providing a latching comparator at said proximal end of said transmission line to receive a resultant waveform which contains a signal component that has been reflected from said shorted distal end;

(d) measuring the amplitude of said resultant waveform at a programmed point in time at said latching comparator by using a technique involving generation of timing strobes in conjunction with a measurement of

amplitude by successive approximation, said technique comprising the steps of:

(d1) providing a programmable voltage reference to which said resultant waveform is compared by said latching comparator;

(d2) providing a programmable time offset for generation of a precisely-timed sampling strobe after said launching of said fast-transitioning waveform in order to sample said resultant waveform amplitude at said latching comparator;

(d3) launching a multiplicity of said fast-transitioning waveform onto said transmission line and adjusting said programmable voltage reference in the manner of said successive approximation until an amplitude representative of a composite of resultant waveform at the given point in time has been acquired; and

(d4) changing said programmable time offset to a next desired point in time and repeating steps d1 through d3 in order to acquire another amplitude representative of a multiplicity of resultant waveform at said next desired point in time until said portions of a waveform have been digitized.

[c022] 22. The method in Claim 21, wherein propagation time of said fast-transitioning waveform through said medium is calculated from said portions of a waveform, comprising the steps of:

(a) determining a characteristic slope of transition from a subset of measured points which represent that portion of said resultant waveform which contains a signal component that has been reflected from said shorted distal end;

(b) locating a point of maximum slope of transition from within said subset of measured points;

(c) determining a baseline reference level from which said signal component that has been reflected from said shorted distal end declines;

(d) projecting a straight line having said characteristic slope of transition through said point of maximum slope to said baseline reference level; and

(e) finding an intercept point of said straight line at said baseline reference level, wherein the time associated with said intercept point represents said propagation time of said fast-transitioning waveform through said medium.

[c023] 23. The method in Claim 22, wherein said propagation time is used to calculate a value for the bulk dielectric constant of the medium in contact with said transmission line.

[c024] 24. The method in Claim 22, wherein said characteristic slope of transition of said subset of measured points is used to determine a value for the conductivity of said medium in contact with said transmission line.

[c025] 25. The method in Claim 21, wherein said medium is soil.

[c026] 26. The method in Claim 21, wherein said medium is bulk grain.

[c027] 27. The method in Claim 21, wherein said medium is bulk paper.

[c028] 28. The method in Claim 21, wherein said medium is lumber.

[c029] 29. The method in Claim 21, wherein said medium is a hydrocarbon fuel.

[c030] 30. The method in Claim 21, wherein said medium is oil.